Robert L. Bates

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The Association of Geology Teachers
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The Editorial Committee includes the editors of the various regional sections of the Association: F. M. Fryxell of Augustana College for the Central Section, Lawrence Whitcomb of Lehigh University for the Eastern Section, and the editor of the newly-formed New England Section.

All persons interested in geological education are invited to contribute. Manuscripts should be addressed to the editor. Brief comments and discussion are also welcome and will be given space so far as practicable.

THE ASSOCIATION OF GEOLOGY TEACHERS

The Association of Geology Teachers exists for the purpose of promoting geological education in all forms and by all means, but especially through the exchange of ideas among geology teachers. Anyone concerned with geological education, formal or informal and at any age level, is urged to apply for membership. Inquiries may be addressed to Mr. Ralph E. Digman, Harpur College, Endicott, N. Y.

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NOTES AND NEWS

National Meeting of A.G.T. The second annual meeting of the National Association of Geology Teachers was held in conjunction with the annual meeting of the Geological Society of America in Boston, November 15, 1952. Officers elected for the coming year, as determined by mail ballot, were announced as follows: president--David M. Delo, Wagner College; vice-president--Joe Webb Peoples, Wesleyan University; secretary--Ralph E. Digman, Harpur College; treasurer--Gerald M. Friedman, Univ. of Cincinnati; editor--William F. Read, Lawrence College. Following a short address by the retiring president, Kurt E. Lowe of the City College of New York, two papers were presented. Julius Kaikow of the City College spoke on "The Role of the Geology Teacher in Conservation Education"; Charles H. Behre, Jr., of Columbia University spoke on "Geology in the American College". Various persons contributed to a symposium on colored lantern slides.

New England Section. A New England Section of the Association of Geology Teachers was organized on October 18, 1952, at Williams College in connection with the annual New England Intercollegiate Geological Field Conference. Twenty-six charter members were enrolled, of which eleven were former members of the Eastern Section. John B. Lucke of the University of Connecticut was elected president; Charles G. Doll of the University of Vermont, vice-president; and Richard E. Stoiber of Dartmouth College, secretary-treasurer.

Eastern Section. The second annual meeting of the Eastern Section of the Association of Geology Teachers was held April 4-5, 1952, at Vassar College. A full schedule of papers was presented on the first day. Ralph Digman of Harpur College, Kurt E. Lowe of the City College of New York, Philip Oxley of Hamilton College, and Irving H. Tesmer of the University of New Hampshire contributed to a symposium on the teaching of historical geology. Other papers were presented

by Cecil Schneer of Hamilton College, W. Taylor Thom of Princeton University, Gerald M. Friedman of the University of Cincinnati, Milton T. Heald of the University of West Virginia, M. Hall Taylor of Columbia University, David M. Delo of the American Geological Institute, George F. Adams and Kurt E. Lowe of the City College of New York, and A. Scott Warthin, Jr., of Vassar College. A lantern slide symposium was held in the evening. Following the business meeting on the second day, Professor Warthin led a field excursion in the Poughkeepsie area.

Section officers elected at this meeting were A. Scott Warthin, Jr., president; Shepard W. Lowman, vice-president; Milton T. Heald, secretary-treasurer; and Lawrence Whitcomb, editor.

Central Section. The twelfth annual meeting of the Central Section of the Association of Geology Teachers was held on April 18, 1952, at Kent State Teachers College, Kent, Ohio, in conjunction with the annual meeting of the Ohio Academy of Science. At a joint session with the Academy, Percival Robertson of The Principia spoke on "The Aims and Purposes of the Association of Geology Teachers"; Ray C. Gutschick of the University of Notre Dame spoke on "Obligations of the Geology Teacher". In a separate session, Robert M. Garrels of Northwestern University and William F. Read of Lawrence College led a symposium on the role of the textbook in the introductory geology course. The field trip conducted by the Ohio Academy on the following day dealt with glacial geology and was under the direction of Dr. George W. White of the University of Illinois.

Section officers elected at this meeting were: R. C. Gutschick, president; Herbert E. Hendriks, vice-president; F. J. Paulus, secretary-treasurer; and F. M. Fryxell, editor.

Third Eastern Conference on Earth Science in Secondary Schools. Number three in a series of annual eastern conferences on Earth Science in Secondary

Schools was held at the Choate School, Wallingford, Conn., on March 15, 1952. According to a copy of the program forwarded to the Journal editor, C. W. Wolfe of Boston University opened the afternoon session with a brief review of the 1950 and 1951 conferences. Ray W. Tobey and A. Austin Meeks discussed the earth science program at the Choate School. Frank B. Conklin described the geology course at Deerfield Academy. Merle A. Sturtevant of Shrewsbury, Mass., discussed earth science from the viewpoint of a superintendent of schools. T. Margaret Jamer, a member of the New York City Board of Education, spoke on "Earth Science in New York City High Schools". John H. Moss of Franklin and Marshall College, Roger Chaffee of the Lancaster Country Day School, and Howard G. Platt of the Germantown Friends School discussed earth science education in schools of southeastern Pennsylvania. (Texts of the Pennsylvania papers appear in this issue of the Journal.) Samuel M. Brownell, president of New Haven Teachers College, discussed problems of teacher training for earth science work. David M. Delo, then president of the American Geological Institute, spoke on the general problem of interesting promising high school students in the field of geology.

The evening session included a brief outline by Richard J. Ordway of the training of teachers for elementary earth science education at the State Teachers College at New Paltz, New York. Prentice G. Downes of the Belmont, Mass., High School spoke on methods of integrating Geology and Physiography with other high school courses. John H. Moss showed the recently completed Franklin and Marshall College film on the training and work of geologists.

Midwest Conference on Earth Science in Secondary Schools. The Earth Science Department of Northern Illinois State Teachers College sponsored a Midwest Conference on Earth Science in Secondary Schools at the Lorado Taft Field Campus, Oregon, Ill., on the eighteenth of October, 1952. Herbert S. Zinn of the Department of Education, University of Illinois, spoke on "The Desirable Functions of Science in the

General Education Curriculum in Secondary Schools". Thomas F. Barton of Indiana University, editor of the Journal of Geography, spoke on "Geographical Material in the General Education Curriculum in Secondary Schools". Arthur L. Howland of Northwestern University took the place of William C. Krumbein of the same institution in discussing the function of geology in the high school general education program as viewed by professors of colleges and universities.

In the afternoon Gilbert Raasch of the Illinois State Geological Survey conducted a demonstration earth science field study through a portion of the Rock River Valley.

Early Publications of the Association of Geology Teachers. Copies of the early mimeographed "Proceedings" of the Association of Geology Teachers are still available and may be secured from the Editor of the Journal, while they last, for fifty cents a copy. Volume 2 is an account of the second annual meeting held at Cornell College, Mt. Vernon, Iowa, May 5-6, 1939. It contains the following papers:

"Geology at Augustana College" (a history) by F. M. Fryxell.
"Tribute to a Pioneer Teacher, J. A. Udden" by F. M. Fryxell.
"The Research Program of the College Geology Teacher" by Edward L. Clark, Drury College.
"A History of the Teaching of Geology at Cornell College" by W. H. Norton.

Volume 3 is an account of the third annual meeting held at Beloit College, April 26-27, 1940. It contains the following papers:

"Methods of Popularizing Geology" by Neil A. Miner, Cornell College.
"Survey of Summer Field Courses" by Robert P. Sharp, Univ. of Illinois.
"Program for the Prospective Graduate Student" by Monta E. Wing, Beloit College.

"Procedure in the Introductory Geology Laboratory at Lawrence College" by Lincoln R. Thiesmeyer.

The Proceedings of the Eighth Annual Meeting held at Hanover College, Hanover, Ind., April 9-10, 1948, contains the following papers:

"Geology in the 'Physical Sciences 3' Course in the College of the University of Chicago" by Lou Williams (reprinted with modifications in the April, 1952, issue of the Journal).
"The 'Two-Cycle' Approach in Teaching General Geology" by William F. Read, Lawrence College.
"The Teaching of Geology at Hanover College" (a history) by Clifford Adams.
"What the Graduate School Asks of the College Teacher of Geology" by Charles H. Behre, Jr., Columbia University.
"Future Opportunities for the Association of Geology Teachers" by Arthur L. Howland, Northwestern University.

The Proceedings of the Ninth Annual Meeting held at the University of Chicago, April 22-23, 1949, contains the following papers:

"Geology at the University of Chicago" by Leland Horberg.
"The Earth Science Course at the State University of Iowa" by Carleton Condit.
"Presenting Professional Geologists" (training professional geologists in a one-man department) by John R. Ball, Univ. of Kansas City.
"Some Problems in Teaching Geology for Engineers" by Erhard Winkler, Univ. of Notre Dame.
"A Plan for the Advancement of Geologic Education" by Ben H. Wilson, Joliet Junior College, Joliet, Ill.

After 1949, papers presented at the annual meetings were submitted to the Journal of Geological Education for publication. The four issues of the Proceedings

mentioned above contain the only available published records of papers presented at annual meetings from 1938 to 1949. (There were no meetings during the war years 1943-45.)

OBLIGATIONS OF THE GEOLOGY TEACHER[1]

Raymond C. Gutschick
University of Notre Dame

This is an appeal to every geology teacher to examine his position critically to determine whether he is doing his best. It is an attempt to state what I personally believe to be the primary ideals and responsibilities of the profession. In my own multitude of shortcomings, it became apparent that the formulation of a code was necessary. I set this goal up for myself to share with others. My remarks are addressed primarily to teachers working with undergraduates, but many of them apply to all geology teachers and even to teachers in other fields.

Why we teach. In these times of economic squeeze, it cannot be said that the teacher chose his profession for the lure of money. There must be a more logical underlying reason. Perhaps the flexibility of a teaching schedule with its generous vacation periods has had some influence, but basically I believe the reason that many of us are in teaching is for the love of sharing knowledge and experience with young people and the great satisfaction of seeing them develop mentally.

The teacher is a public servant entrusted with the stewardship of his students. In spite of economic difficulties we should evaluate our position in society and accept the responsibilities of our chosen lot. If we are not willing to accept these responsibilities, we should apply our talents in other directions. This is an important point which should be impressed upon the younger members of the profession and those who are thinking of going into teaching.

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[1]Read in original form at the joint annual meeting of the Midwest Section of the Association of Geology Teachers and the Ohio Academy of Science, Kent State College, April, 1952. This is a somewhat modified version.

We must always keep the welfare of our students uppermost in our minds. It is clear that the majority of geology teachers are genuinely devoted to this end, though there are of course some exceptions. With the tenure system in vogue at most institutions there is a tendency to become complacent about teaching responsibilities once permanency is reasonably assured.

Relation of a teacher to his department. Every teacher (unless he is a department in himself) is a member of a department and has a responsibility to see that the department properly fulfills its functions. The first objective of the department is to provide a satisfactory curriculum consistent with the size and overall objectives of the school. This is no small task, especially in view of the recent trend toward emphasis on quantitative aspects of geology. The undergraduate department must prepare the student for graduate school, for industry, or for government service. It must give him the preparation necessary to pass such qualifying examinations as those administered by the United States Civil Service. The department has the job of providing adequate teaching facilities in the way of laboratory equipment, lantern slides, etc. Budgetary matters must be given fair consideration from the viewpoint both of needs of the department and means of the school. If something is vitally needed, the department should be adamant in its effort to secure same.

The department shares with the school administration the task of arranging an equitable distribution of teaching load. The department should provide for outside speakers who can furnish new ideas and new perspectives to stimulate the students and staff. The department should encourage and provide for participation of its members in national and regional organizations, geologic field conferences, and the like. It must see to it that the staff is provided with adequate facilities and time for research. Research should not be allowed to supplant or interfere with teaching but rather should serve to increase teaching effectiveness.

Within the department the watchword must be unselfish cooperation. Individuals should not allow temperament to interfere with the realization of departmental goals. The department should be run in a democratic fashion, but it is not to be understood by this that individual freedom should take precedence over departmental unity. Active objective discussion within staff meetings is healthy provided there is general support and cooperation once decisions have been reached. It is no secret that there are departments of geology whose members are openly at odds with one another. In some cases the situation is not short of scandalous. This sort of childishness is not conducive to good relations between teachers and students and should not be allowed to grow. That it has grown is evidenced by the fact that in some instances antagonisms have been publicly aired for over a decade.

Departmental brochure. An important contribution which the department as a whole can make is the preparation of a brochure for students. This should contain information which will be of value to geology majors in all stages of advancement as well as to those who may be contemplating just a single course in the subject. It should include a brief, nontechnical description of what geology is. It should explain how geology is used. There may be a section on the local geology, with suggestions as to field trips. Attention may be called to geological exhibits and museum displays. The American Geological Institute's pamphlet "Shall I Study Geological Science?" may be drawn upon to good advantage--likewise their bulletin "Earth Science for the Layman"[2], an excellent annotated bibliography of popular reading on various geological topics. For more advanced students, the circular on "Training Geologists: A United States Geological Survey Viewpoint"[3] contains valuable suggestions.

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[2]Edited by Mark W. Pangborn, Jr. A.G.I. Report No. 2, June, 1950.

[3]By N. M. Bannerman and W. T. Pecora. U.S.G.S. Circular 73, March, 1950.

The brochure should discuss specific course programs preparatory to various types of professional work. It should give statistics on the number of geologists currently employed in these fields and on their salaries, tasks, qualifications, geographical distribution, etc. There should be statistics too on the number of students in training. The A.G.I. directory of "Departments of Geological Science in Educational Institutions of the United States and Canada"[4] affords an accurate picture of the academic machinery for training geologists in this country--and of the opportunities for prospective teachers.

Details of procedure for securing various jobs should be discussed. Suggestions may be made regarding applications, interviews, and "contacts". State and federal civil service examinations for geologists should be adequately described.

A multitude of other related information can be made available. Certainly the existence of such a brochure will indicate to the student that the department is genuinely interested in helping him find his niche. Some departments have already prepared such material for their students.

The teacher as an example to students. A man hired as a teacher should be examplary in professional training and demeanour. Not only the institution's administration but also the students should be entitled to know the teacher's qualifications. Such publications as "American Men of Science", "Who's Who in America", and "Who's Who in American Education" may give biographical sketches, but the student seldom consults these sources. It is up to the teacher to forego modesty and make known his educational background and experience in detail.

Personality is a very important factor. The student should have respect for the teacher, not

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[4]Edited by Shepard W. Lowman. A.G.I. Report No. 6, March, 1952.

because of the course-grade ax that he may feel is over his head, but for the man himself. The same qualities which are sought for and developed in students should be exemplified by geology teachers.

Relating experience to teaching. A Teacher should not hesitate to give his all or "put out" to the best of his ability and in full measure. This applies to his training in both theoretical and practical geology. So often experience gained in commercial work or consulting (aside from that which is confidential) is alluded to very casually or just not mentioned. There is some tendency to rely wholly on "book learning". Practical information supplementary to theory is fundamental. It is the duty of all geology teachers to integrate their courses so that the full benefit of their training and experience can be passed on to students.

Participation in student affairs. Participation in student affairs, including the geology club, should be voluntary but forthcoming. Students should be encouraged in their efforts to arrange their own speaker programs, field trips, etc.

Professional meetings. Attendance at technical meetings, either to present scientific papers or to represent the university and keep current with the field, is one of our obligations. Contact with other workers in all phases of geology will certainly benefit us as teachers.

Public Relations. Personal relations should be pleasant with students, faculty, administration, and particularly the general public. This latter cannot be emphasized too much, for the individual teacher has a very powerful potential influence which can do much to create or destroy good will toward the science as a whole. A recent trend in thinking within the Public Relations Committee of the American Geological Institute is that geologists as an organized group can oversell their products with the wrong kind of publicity. The greatest service to the profession is

rendered by geologists at the individual level. The geology teacher should seize every opportunity--including lectures, radio talks, and field trips--to demonstrate to the public the practical nature of geology. The A.G.I. has published a booklet entitled "Suggestions for a Program of Public Education" which can be helpful in this effort. We should do everything we can to cooperate with organizations which are trying to promote the welfare of our science.

Recreation. If a teacher has a particularly heavy schedule semester after semester, or if his course work is essentially the same year after year, he may become stale and develop an indifference to his subject and students. In order to overcome this the teacher should find some means of diversion either within or outside of his field. Periodically it becomes necessary to refresh and stimulate one's self. This can be accomplished through travel, sports, field work, and in many other ways. An occasional exchange of teachers between institutions is sometimes highly beneficial.

General attitude toward students. One point which is often overlooked by teachers is that parents have an important stake in the matter when they select a school and place their offspring under the care of its administration and faculty. The college teacher assumes to some degree the role of parent. He must not regard his students as chattels or transients but give them the same warm human care he gives his own family.

Be honest with students. The student is not so naive that he cannot detect bluffing. He is not deceived by the teacher any more than the teacher is deceived by the student. Many times small actions on the teacher's part can mean the difference between inspiration and frustration to the student. The successful teacher will be a good judge of mankind and human nature.

Evaluation of students. In judging a student's

potentialities the teacher must take pains to discover whether his showing on examinations, etc., is due to high native intelligence and natural aptitude or whether it has been achieved by persistent toil. A student may have an interest in a subject which will cause him to work at it long and hard, but if he has no natural aptitude he will eventually bog down in his studies.

Most universities and colleges have testing and guidance departments which administer standard tests to incoming freshmen. The American Council on Education's "Psychological Examination for College Freshmen" examines aptitude. The "Cooperative English Test" tests the student's use of English and his reading comprehension. Various "Cooperative Achievement Tests" examine the student's knowledge of the social sciences, natural history, and mathematics. These are just a few of the tests whose results can be placed at the disposal of the teacher. The teacher should make an effort to examine the results of these tests for every incoming freshman in order to administer the most effective, personalized teaching.

Counselling. Regular office hours for consultation and advice are a must. Many good students are eager to obtain guidance and come in for counselling of their own accord. On the other hand, some "bright" students feel that they do not need counsel, and the failures who need it most do not seek it. In such cases the teacher must take the initiative. It is a tragic fact that many potentially capable students languish due to lack of interest or imagination on the teacher's part. The confused state of the world and the prospect of military service are undoubtedly conducive to lethargy but this does not mean that lethargy cannot be cured. It is a challenge to teachers to inspire such students to direct their efforts into productive channels.

Counselling should be personal, informal, frank, and objective. Genuine impartial personal interest above all will have a dynamic impact on the student

and motivate him to do better. There should be no coddling. If after careful consideration it is felt that a student should be discouraged from continuing in a particular field or program, it is the duty of the teacher to do so without delay. This may be doing the student a great favor.

Job applications. From government, industry, and educational institutions, the teacher receives application and recommendation forms which set forth the qualities which the various organizations seek in young men. It should be the duty of the teacher to make these qualities known to the student at an early stage so he can strive to develop them in his undergraduate days. He is likely to do a much better job if he is aware that he will eventually be graded on some sort of a personality scorecard.

Counselling superior students. Personal interest and guidance assumes a special form when the teacher is helping the student with an honors program or a senior thesis. This is true also when the student is serving as a research assistant. Superior students need to be encouraged to work for awards of merit such as scholarships, honors at graduation, and election to honorary societies. They should also be encouraged to undertake the responsibilities of leadership in local clubs.

Encouraging graduate study. Many students should be strongly encouraged to go on into graduate studies. A paper presented by Professor Behre of Columbia University at the 1948 annual meeting of the Association of Geology Teachers will be found useful in this connection.[5] Many times the student has no idea that he is capable of qualifying for graduate school. Often lack of financial assistance stands in the way. The majority of students are not aware of the numerous

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[5]Behre, Charles H. Jr., "What the Graduate School Asks of the College Teacher of Geology," Proc. 8th Annual Meeting of the Association of Geology Teachers, April 9-10, 1948.

generous financial aids which are available in the form of scholarships, fellowships, and graduate assistantships. Recently industry-sponsored fellowships have been granted to first-year graduate students. The student should be told early in his college career of the great opportunities which are available through these grants provided he can establish a satisfactory scholastic record.

There will be certain students who will show no desire to continue with graduate work whether financial assistance is available or not. It should be emphasized to these students that graduate work is becoming more and more a prerequisite to employment. A four-year degree is not a professional degree and cannot qualify the student for professional work within the field of geology. Some companies which hire four-year men regard them merely as technicians, with very limited opportunities for advancement.

Helping students find jobs. If it is not possible for the student to go on to graduate school, the teacher should do all he can to get him well placed. It has been my experience that if a four-year man shows initiative, tenacity, and patience in seeking employment, jobs can be found. Effective aid can be rendered in helping seniors prepare for civil service examinations.

The brochure can be useful to the student seeking employment for it can summarize the current employment situation and list the companies and institutions which are using geologists. Personal contacts can be suggested. Most institutions have placement bureaus which post job opportunities and arrange for interviews. The American Geological Institute also has a placement service.

Job forums. A recent innovation on the programs of professional society meetings (G.S.A.; Detroit, November, 1951; Tucson, April, 1952; and Boston, November, 1952. A A.P.G.; Tulsa, May, 1952; and others) is the inauguration of job forums for students,

with a panel of geologists representing industry, government, and education. Both student and teacher can profit from these discussions. They afford a clear picture of the current employment situation as seen by men who are close to the source. A valuable aspect of these forums is the opportunity for students to direct questions to any member of the panel. At the G.S.A. forum in Detroit, 1951, Dr. John T. Rouse of the Magnolia Petroleum Company pointed out that teachers should know more about the companies that hire geologists. Conversely the companies have an obligation to furnish the teaching profession with appropriate information for students seeking jobs.

Alumni. Once the student is graduated he will represent the school and its geology department the remainder of his life. The department should formulate a live program for keeping in contact with its alumni and maintaining their interest in departmental affairs. This can be achieved to some extent by newsletters. It is suggested, however, that the teacher can best promote alumni loyalty by personally keeping in touch with the graduates through occasional correspondence. Of course, in large departments where the graduates may number in the hundreds it is hardly possible to keep in direct touch with all of them.

Method of approach in individual courses. The method of approach in each individual course will depend upon whether the course is designed as a "cultural" course for non-majors, or whether it is directed toward students who expect to become professional geologists. Some courses must be planned to fit the needs of students of both types. In all courses the teacher should work from observed data to general principles--not vice versa. A prime objective should be to get the students to think clearly and develop a discipline of geological reasoning. The accumulation of factual knowledge will follow as a consequence. Every course should give the student some experience in applying principles of practical problems. Likewise every course should be related to other courses, not considered as an isolated unit

in itself. Above all, the teacher must be properly qualified to teach the subject or course which is assigned to him. He must be able to add the wisdom of his own personal experience to textbook theory. Students should be constantly encouraged to seek further information on particular subjects through library reading. Too much reliance on textbooks and class notes is a habit to be discouraged.

Organization. The success with which a subject is presented will be directly proportional to the manner in which it is organized. Everything should be made crystal clear through efficient arrangement of material. This is not to say that the student should have everything served up to him on a platter and then be spoon fed. It means that the course should be planned and organized so that it can be taught and studied rigorously. The procedure should not, however, become fixed. Flexibility is required to keep a course abreast of the times.

Classroom methods. As to the manner in which a course is presented in the classroom, the time-honored system of lecturing seems to prevail in larger classes and in all probability will continue to do so unless something better can be devised. In smaller classes, seminar-type discussions can serve a very good purpose. Any lecturing which is done in small classes should be strictly informal. Oral quizzing is an effective procedure. Discussion, properly directed, stimulates students and challenges them to think.

Demonstration materials--such as minerals, rocks, fossils, maps, drawings, models, lantern slides, and movies--should be used to supplement class work. The teacher should be careful to avoid pedantry. He must maintain an attitude of honest humility. A pitfall which is common in the teaching profession is the reluctance to admit to a lack of knowledge in certain things. Some teachers assume an aura of omniscience. This leads to bluffing, hedging, and even ignoring the student's earnest desire to seek the truth. Honesty will continue to be a sound policy, for only

by stating the truth about what he does not know can the teacher inspire the student to seek further knowledge on his own.

Size of classes. The number of students, especially in larger classes, will be determined by the department. Both student and teacher must be given fair consideration in this, for too large a group can be a handicap to both. Student-teacher ratios must be carefully determined to suit each situation.

Adjusting the degree of difficulty. After a class is assembled, the teacher should try to determine the intelligence, aptitude, and industry of each student in order to pitch the class work at the proper level of difficulty. The course should not be over the heads of the majority nor should it be too simple for the brighter students. With the throttle set at some median point the class can proceed at a suitable rate.

Use of notes. The teacher in his lecturing should not be so "note-bound" as to handcuff his thoughts, nor should he expect his students to take such profuse notes that they do not have time to think about what is being said. In most cases it is necessary to lecture from an outline, but the lecturer will speak with more wisdom if he allows himself to think as he goes along instead of merely reading from voluminous notes. I have seen cases where a lecturer's class notes were yellow and brittle with age, obviously indicating that they were used year after year with little or no modification.

Speaking manner. Lecturing should be done with verve and enthusiasm. Public speaking is an art--one which is not acquired at birth but achieved through diligent practice. Words are dynamic and one should select them carefully to express his thoughts. I believe the goal in classroom lecturing is to convey the subject matter thoroughly and with sufficient meatiness but in such a manner that it will have popular appeal to the students. Use inflections and crescendo to avoid listless monotone. Satisfaction

comes when one can sense profound interest and concentration on the part of the audience--a "meeting of minds".

Assignment schedules. Class assignments can be indicated by issuing mimeographed assignment sheets which will outline the work of a complete quarter or semester. This serves several worthy purposes. It gives the student confidence in the beginning that the course is carefully organized. It also lets him know precisely what is expected of him. The student equipped with such a schedule will have no excuse for failing to meet his classroom obligations.

Outside reading. In addition to text reading, it may be desirable to assign outside reading which will give students the opportunity to use the library. In this case it is wise to let them choose from a list of references in the form of an annotated bibliography, giving them a specific number of pages to be read in reasonable periods of time. If outside reading is merely "recommended", I have found that undergraduates, in spite of all my encouragement and pleading, lack initiative to explore and use the library as they should.

Some courses attempt to bring in a tremendous amount of outside reading material, with the resulting danger of causing the student to bog down in confusion. Reasonable limitations must be put on the amount of outside work, consistent with course credit hours. On the other hand, students tend to neglect courses where there is little required and concentrate out of proportion on those courses which inundate them. Teachers should not take unfair advantage of this fact, however, to get more work done in their own courses. In fairness to all concerned the teacher should limit the amount of work he assigns to what he may reasonably expect good students to accomplish in the allotted time.

Texts. Textbooks serve a good purpose in undergraduate work and for many courses there are suf-

ficiently good texts. A good textbook should be lucid, up-to-date, and unbiased. Careful organization is as vital in textbooks as it is in lectures. After studying some of the recent textbooks and reading published reviews, I begin to wonder whether the authors have the student's interest at heart or whether the extra income might be more important. Some texts lack continuity and are full of duplications, omissions, and inaccuracies. Everything is done piecemeal with little effort toward organization and unification. This suggests that the author may be in too much of a hurry to satisfy the publisher's demands. Of course, it is no easy task to write a good textbook, and reviewers in some cases may be a little too harsh in their criticism. On the whole the field of geology is blessed with many excellently-thought-out and well-written textbooks. The authors, who by this means have shared their experience and insights with the teaching profession generally, should be given a resounding vote of thanks.

Quizzes and examinations. Short written quizzes, whether announced or not, serve the purpose of finding out whether the student is keeping up with his daily assignments and on his toes in the classroom. Longer and more comprehensive examinations should be announced. They put pressure on the student to review larger segments of the course and add perspective to his thinking. Such examinations should be both thorough and rigorous. Students have a right to expect this type. In grading, a premium should be placed on the degree of clarity and succinctness with which the student answers questions. A long, thorough examination may make the student overly time-conscious and thereby handicap his thinking, but in the long run he must develop the ability to handle questions quickly and accurately. An incidental advantage of "tough" examinations is that they do not give students time to cheat.

Conclusion. Just as the student is the teacher's obligation, so also is he the teacher's reward. What gives more satisfaction than to see the student enter

geology, mature throughout his undergraduate training, and finally succeed beyond expectations? This is the real compensation of doing a good job.

At the Association of Geology Teachers meeting in Detroit, November, 1951, Dr. David M. Delo suggested that a geology teacher be selected and honored annually for outstanding achievement. I think this an excellent suggestion. Such an award by the Association of Geology Teachers should rank equally in importance with the Penrose Medal of the Geological Society of America, the Roebling Medal of the Mineralogical Society, or the Sidney Powers Memorial Medal of the American Association of Petroleum Geologists.

General References

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A WORKING SCALE MODEL OF A SALT DOME[1]

G. F. Adams
The City College, N. Y.

Geology teachers are somewhat baffled when the presentation of internal processes appears on the class schedule. We must usually be content to examine either surface manifestations or structures made underground and later exposed. In the nature of things, this will be a source of frustration for some time to come. One ray of hope stems from the use of dynamic scale models. These attempt to reproduce in a short time and in small space a corresponding earth operation. Most of these operations involve heat transfer and are difficult to handle in the scale model. One which does not is the formation of salt domes in horizontally bedded sediments.

Field observation and mechanical analysis[2] indicate that under sufficient confining pressure a salt layer will dome by plastic deformation induced by slight pressure differences on the surface of the relatively light salt layer. The theoretical system is sufficiently simple to reproduce in small scale and at small cost. The system can be seen to operate in from 15 to 20 minutes. It may be used as a lecture demonstration or as a laboratory experiment.

Theory. The formation of salt domes in the earth requires a layer of salt of indeterminate thickness

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[1]Demonstrated at the second annual meeting of the Eastern Section, Association of Geology Teachers, Vassar College, April 4-5, 1952. The writer does not consider himself an authority on scale models in general nor on salt domes in particular. The model described may not be theoretically ideal, but it has proved very useful in the classroom.

[2]Nettleton, L. L. "Fluid Mechanics of Salt Domes" Bull. Am. Assoc. Pet. Geol., Vol. 18 (1934), pp. 1174-1202.

covered by about 20,000 feet of sediment, plus a long period of time. We propose to demonstrate this phenomenon in a sealed glass jar sufficiently high so that the overburden can be represented by a layer 15 centimeters thick. Since 20,000 feet is equivalent to $7(10)^5$ centimeters, the model/earth length ratio is $15 \div 7(10)^5 = 2(10)^{-5}$. To make a true scale model operating at low acceleration, three additional ratios must be selected so as to satisfy the following relation:

$$\psi = \delta \lambda \tau$$

where ψ is the viscosity ratio, δ is the density ratio, λ is the time ratio, and τ is the length ratio.[3] The length ratio being fixed, selection of any two of the remaining three will fix the third. Thus if a viscosity and density ratio are selected, the time ratio will be fixed. In practice this is the only possible selection, since the earth densities and viscosities are known, while the earth time can only be approximated. In fact, one of the values of the model is that it provides a basis for computing the earth time involved. The practical key to the whole experiment is to find materials to represent the salt and overburden with viscosities and densities such as to give identical density and viscosity ratios for the two materials (See table). An additional requirement is that the model viscosities be such that the model may work in the allotted time.

Specifications. The container used by the writer is a heavy rectangular glass museum jar with a glass cover. The jar is 20 cm. deep, and 13 x 13 cm. at the top. The overburden is a colorless "Karo"[4] syrup (red label) heated for several hours in a large metal container until it boils at 116° C. At room temperature, the viscosity is about $6(10)^3$ poises. The

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[3] Hubbert, M. K. "Theory of Scale Models as Applied to the Study of Geologic Structures", Bull. Geol. Soc. Amer., Vol. 48 (1937), pp. 1459-1520.

[4] Manufactured by Corn Products Refining Co., Argo, Illinois.

TABLE OF MODEL-EARTH RATIOS

	Earth	Model	Ratio	Symbol
Height of System	$7(10)^5$ cm	15 cm	$2(10)^{-5}$	λ
Width of dome	$2.25(10)^5$ cm†	4.5 cm*	$2(10)^{-5}$	λ
Density of "salt"	2.2 gr/cm^3	1 gr/cm^3	0.45	δ
Density of "overburden"	2.5 gr/cm^3	1.3 gr/cm^3	0.52	δ
Viscosity of "salt"	10^{19} poises	$6(10)^2$ poises	$6(10)^{-17}$	ψ
Viscosity of "overburden"	10^{20} poises	$6(10)^3$ poises	$6(10)^{-17}$	ψ
Time	$6.3(10)^6$ yrs†	1200 sec*	$6.1(10)^{-12}$	τ
Velocity	0.09 cm/yr†	0.01 cm/sec†	$3.3(10)^6$	$\rho = \frac{\lambda}{\tau}$

† = Value computed from appropriate ratio.
* = Value derived from observation in a typical experiment.

"salt" layer is an asphalt obtained from the Esso Company[5], called "Ennjay 180/200 Penetration Asphalt", with a viscosity of about $6(10)^2$ poises. Using 10^{20} poises as the viscosity of the overburden in nature and 10^{19} poises as the viscosity of the salt, the viscosity ratio for both salt and overburden is $6(10)^{-17}$.

The density of the asphalt is about 1 gr/cm^3; that of salt is 2.2 gr/cm^3--giving a ratio of 0.45. To get the same ratio for the overburden, using 2.5 gr/cm^3 for the overburden in nature, the corn syrup should have a density of 1.12 gr/cm^3. Actually it runs about 1.3 and the resulting ratio of 0.52 introduces a distortion in the model. The distortion is not serious since the density is being reduced by only about one half in the model, the large reductions being in length and viscosity. This can be confirmed by calculating the time ratio using the two different density ratios (0.45 for the asphalt and 0.52 for the syrup). The first gives a time ratio of $6.6(10)^{-12}$; the second, $5.7(10)^{-12}$. This comparatively small spread may be averaged to $6.1(10)^{-12}$.

Preparing the model. After boiling the syrup, permit it to cool so that it will just pour easily and fill the museum jar up to about 2.5 cm. from the top. Then allow the syrup to cool to room temperature. Cover the syrup with a layer of asphalt sufficient to fill the jar. With as little air as possible in the jar, seal on the glass cover with a good glass-to-glass cement. The model is now ready to operate.

Operation. With a firm hand on the cover, the jar is inverted to an inclined position in order to induce a slight bulge on the surface of the asphalt. It is preferable to have this bulge to one side, since the first dome to form will develop an air bubble on the top, making it dimensionally inaccurate. Later domes will be air free. Each dome should take some 15 minutes to reach the "surface" of the model. Eventually

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[5]Esso Standard Oil Co., 15 W. 51st St., New York, N. Y.

the series of domes will carry most of the asphalt to the top of the jar. This may require several hours. When this has occurred, the jar may be inverted to its original upright position, and a new set of domes will form. Reversals might be repeated indefinitely were it not for the tendency of asphalt stringers from pinched-out domes to remain in the middle of the syrup. All operations should be performed over a large developing tray as a precaution against leaks around the glass cover.

Using the model as a demonstration. With the model before the students in the inoperative position (asphalt at top), introduce them to the general theory of scale models and its application to the model at hand. The partially filled ratio table may be exhibited so that the specifications of the model can be discussed. The model is then inverted to the tilted position to raise the bump on the asphalt, and left upside down on the table. As a dome starts to rise, the instructor may keep a running account, which will cover the following points.

1. Start of the operation. The starting time should be recorded.
2. The "sink" surrounding the dome, which is not too visible in the model, but can be illustrated on the blackboard.
3. Short initial period of acceleration, followed by a fairly constant rate of rise.
4. Stage when the walls of the dome start to overhang, and the final pinching out of the base.
5. Effect of the presence of the air bubble.
6. Flow directions of both asphalt and syrup. These may be illustrated by an auxiliary diagram. The model flow at different stages and the corresponding earth structures, such as folding and faulting, may be discussed.
7. Effect of the glass at the top of the model. If the model surface were exposed to air as a salt dome system is in nature, a very slight bulge might occur corresponding to the low mounds found above some salt domes. As in

nature, the bulge would never get very high for various reasons. The glass, then, merely prevents a relatively minor "topographic" effect, without interfering with the validity of the model.

8. Significance of the development of successive domes. Point out that natural salt domes usually appear in groups, and suggest the reason.
9. Time required for the dome to rise. When the first dome has come to about 2 cm. from the top, record the time and find the time interval from the start. A rough calculation may be made of the time needed for a corresponding dome to rise in the earth. By means of the velocity ratio, the velocity of the corresponding earth movement can also be approximated and shown to be small.

Using the model as a group experiment. The same preliminaries are performed as in the demonstration. A sheet of frosted acetate film,[6] cut to size, is affixed to one side of the jar when the dome is about to start. One student acts as timer, another as tracer. At stated intervals (one or two minutes) the outline of the dome is traced, until the dome is about 2 cm. from the top. The first dome, with the air bubble, may be used for practice. Fresh sheets of film should be affixed for recording the movement of each subsequent dome. With the data thus obtained, the students may calculate (1) the width of a corresponding earth dome, (2) the time required for an earth dome to rise, and (3) rates of ascent in both the model and the earth. The student may be asked to deduce from recorded changes in dome form and position the flow lines in both "salt" and "overburden". He may also be asked to relate the flow to structures associated with actual earth domes. The student's report of the experiment should include a discussion of its general validity.

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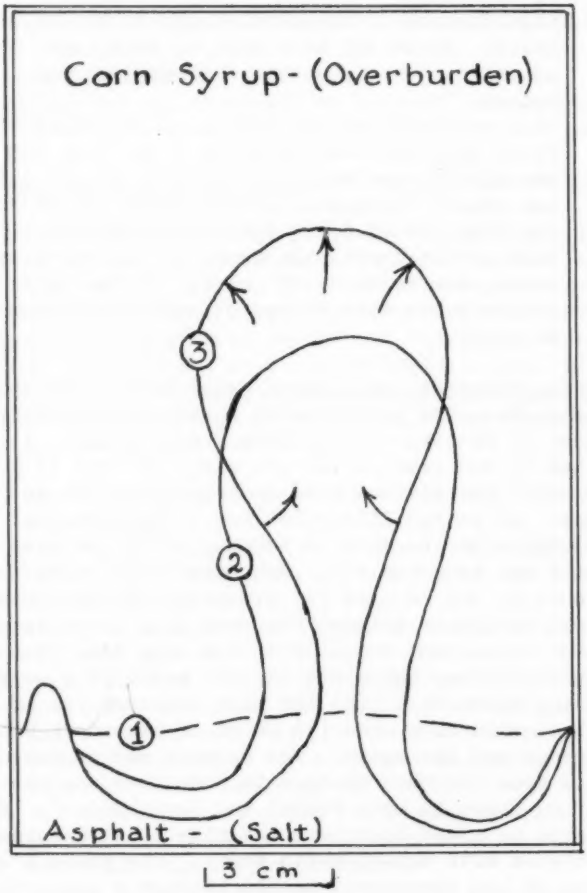
[6]Obtainable from the Lustro Company, 117-125 E. 13th St., Chicago 5, Ill.

Whether used as a demonstration or as an experiment, this model has a peculiar fascination for both student and instructor that well repays the trouble of making it.



SUCCESSIVE PROFILES OF RISING "SALT" DOME

The curves indicate (1) initial swell on the "salt" (2) well developed dome--walls starting to overhang (3) dome almost pinched off at base; second dome starting in left corner. Arrows indicate directions of flow in stage (3) as deduced from profiles (2) and (3).

A WORKING SCALE MODEL OF A SALT DOME: DISCUSSION OF PAPER BY G. F. ADAMS

L. L. Nettleton
Gravity Meter Exploration Company, Houston, Texas

I am glad to see a paper of this kind as it is gratifying that interest in salt dome models, originally made in 1932, has reached the classroom stage.

A few additional references which should be included in any paper on this subject are listed below. There are others which should appear in a really complete bibliography.

The model-earth ratios have been given with more certainty than is justified, as some of the factors involved are not at all well known. This aspect has been considered in some detail in Dobrin's paper which is included in the added references.

Some minor modifications in the preparation of the model would make for definite improvement. In the first place, the viscosity of the asphalt should be nearer that of the syrup. Otherwise the asphalt tends to be pinched off more than appears to be representative of conditions in nature. In the second place, any air bubbles in the model introduce a component which has no counterpart in nature, and the model should be made without bubbles. This can be done in the following manner. Heat the jar slowly in an oven (to prevent cracking) and pour in the syrup boiling hot. The asphalt can then be put on over the hot syrup and a little more added as the jar cools to fill level with the top surface. The air bubbles will rise up out of the hot syrup and to the surface of the asphalt. Final small bubbles, which appear as little blisters on the asphalt surface, can be broken by brushing them with the flame of a Bunsen burner. In this way it should be possible to make a model with no air bubble after it is sealed.

The following remarks refer to the numbered items for discussion under "Using the model as a demonstration":

Item 4. The start of an overhang and the "final pinching out of the base" depend on the relative viscosities of the syrup and asphalt. In nature any pinching off of the salt column has never been established and it is probably rare as it is not indicated by geophysical results. Therefore, a model which shows this effect is certainly not properly scaled. As mentioned above, this difficulty can be avoided by using an asphalt of higher viscosity.

Item 5. As mentioned above, the air bubble has no counterpart in nature and therefore should be eliminated in making the model.

Item 6. Flow directions in the syrup can be followed, if desired, by stirring into the syrup very small pieces of thin paper (large enough to hold a single typewritten letter) and marking the course of a few appropriately located pieces with wax crayon on the side of the jar.

Item 7. The glass top of the model has no counterpart in nature. If the top were not there the asphalt would come to the surface and flow out on the syrup rather than make a low mound. Therefore I cannot agree with the statement that "As in nature, the bulge would never get very high for various reasons." Any fluid model fails in providing a mechanism by which the salt dome stops growing. The actual mechanism in nature probably involves a definite strength (resistance to shear) and an elastic limit in the sediments. These factors have no counterpart in the fluid syrup (see paper by Nettleton and Elkins).

Item 8. A small model of this kind should never be allowed to flow to the extent that more than one dome is formed. To preserve its original status, it should be inverted to its stable position before the first dome gets very near the surface, and definitely before there is any pinching off of the "salt" column. This will avoid the formation of threads of asphalt in the syrup and make the model more permanent. The threads of asphalt break off and form strings of very small drops or beads which are too small to rise out of the syrup. They can be removed by heating the entire model but this probably would require removing the sealed glass top plate because of expansion of the fluids.

The suggestion that natural salt domes appear in groups may be true, but the model cannot show this condition properly because the ratio of its horizontal to vertical dimensions is not great enough. To show groups of domes the horizontal dimensions would have to be many times greater than the vertical.

Item 9. If time measurements are made, they should not be continued until the dome has come close to the surface. This is because of the constraint imposed by the glass top, which, as mentioned above, has no counterpart in nature.

Additional References

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Nettleton, L. L. "Recent Experimental and Geophysical Evidence of Mechanics of Salt Dome Formation," Bull. A.A.P.G., Vol. 27, No. 1 (1943), pp. 51-63.

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A GEOLOGY COURSE FOR WELL DRILLERS

George K. Biemesderfer
Franklin and Marshall College

One obstacle to the growth of geologic knowledge in Pennsylvania is that well drillers have not kept systematic logs and records. To help overcome this deficiency in Lancaster County, an experimental course in geology for well drillers was recently given by the Geology Department of Franklin and Marshall College.

The aims of the course were to present fundamental principles of ground-water behavior, familiarize drillers with local rock formations, and enlist their aid in keeping records useful to geologists.

The mechanics and content of the course were carefully designed for individuals with little previous knowledge of geology. Four sessions, each an hour and a half long, were held on successive weeks. Lecture material was drawn from a standard general geology course but modified to emphasize the geology of Lancaster County. An effort was made to keep the explanations on so elementary a level that the most inexperienced driller's helper might understand.

The first lecture explained how igneous, sedimentary, and metamorphic rocks are formed. The second lecture dealt with the structures in rocks and how those structures affect the passage of ground-water. Then followed a lecture on ground-water hydrology. The concluding discussion was on the geology and ground-water of Lancaster County. Constant reference to local ground-water problems and drilling difficulties had the apparent effect of making geology reasonable and acceptable.

A complete suite of rock types that crop out in this area was prominently displayed and referred to frequently. The suite consisted of the usual hand specimens and, more important to the drillers, bottles

of sludge and cuttings from each formation. Cuttings had been obtained, wher possible, from drill-hole bailings, but some equally authentic-looking samples had been prepared in the laboratory by wet grinding. The purpose in providing the cuttings was to suggest that rocks can be successfully identified by examination of drilling sludge. The cuttings also served the equally important function of impressing the drillers that this familiar material would be of inestimable aid in mapping geology. Considerable stress was placed upon the importance of recording and sampling formation changes. Mimeographed notes, for the drillers' future reference, summarized known water yields of each formation. The geologic explanation for high or low yields in representative wells known to most of the drillers was discussed.

The subject of rock terminology was emphasized whenever possible. The vague term "trap", for instance, has been applied in southeastern Pennsylvania to silicified limestone, granite, quartzite, and diabase. Erroneous terms and meanings are well established with most drillers and it was difficult in this course to correct their word usage.

The response to the course was highly gratifying. Sixty-five persons attended. The registration list included, not only well drillers and helpers, but also members of an exploratory drilling crew from a highway construction firm, pump repairmen, power plant engineers, representatives of a commercial water softening and purifying company, civil engineering consultants, and state Board of Health employees. Several drillers offered to cooperate by providing locations, logs, and pumping yields of their future wells asking only that the college supply sample bags.

Most reassuring of all was the discovery that well drillers and others interested in ground-water will respond to offers of geologic training. The association of geologists and well drillers in the classroom established an understanding of mutual problems and cleared the way for future cooperation.

PROSPECTING - AN EXTENSION COURSE

William C. Peters
Idaho State College

In the Mountain West, where prospecting is a tradition, geology needs no introduction to the public. An evening course in prospecting offered by a college geology department finds immediate acceptance in the community.

The current course at Idaho State College was first offered in 1950 and has been repeated three times. In contrast to the general pattern of extension classes, there are no college prerequisites and no college credit is given. The class meets one night each week for eighteen weeks and is roughly equivalent to a three-credit-hour course.

In every class group there has been a wide range in age and educational background. The students have included miners, businessmen, professional men, experienced prospectors, and faculty members from other departments. Many enrollees are mineral collectors or amateur gem cutters. A common interest in rocks, minerals, and mountains has made every class meeting an enjoyable experience for the instructor as well as the students. The end of the period does not result in a rush to the door, as in daytime college classes, but rather brings about a general discussion of some phase of geomorphology, the earth's interior, or historical geology. Originally, the course was planned to include only "applied geology". Postclass discussions have, however, touched on a great many academic points and have brought forth some new and original approaches to geologic problems. A majority of the most interested students have had little formal schooling but have developed in its stead a good store of observation and experience.

A textbook, "Handbook for Prospectors" by M. V. Von Bernewitz, is used and assignments are made

corresponding to class work. Several men have purchased introductory geology texts for additional reading.

The three-hour meeting is divided into a lecture period and a laboratory period. In the laboratory, a new project is instituted every week and the work from previous weeks is continued. Backgrounds and specific interests differ so widely that everyone is given an opportunity to dwell upon one phase as long as he wishes--whether it be minerals, rocks, or geologic maps.

The course is divided into five major parts as follows:

1. General Geology (six meetings). This comprises an introduction to minerals, rocks, and structural geology. Mineralogy is approximately the same as that included in physical geology laboratories, with major emphasis on physical identification. Crystal systems are briefly described and the most common cleavage and crystal forms discussed in detail. A few simple blowpipe tests are demonstrated; further practice in this phase is, however, left entirely up to the individual. Among the more experienced prospectors, many have tried blowpipe tests beforehand with varying degrees of success.

A separate period is devoted to each of the three major rock classes. A common familiarity with nearby volcanics of the Snake River plains neccessitates some extra discussion on structures of lava flows.

Simple geologic structures are presented and some emphasis is placed upon the geometry of faulting and upon post-mineral faulting problems.

In this portion of the course, laboratory work centers about physical identification of the common rocks and rockmaking minerals. Practice trays of rocks are composed of types widely distributed in central and southern Idaho.

2. Mineral Deposits (six meetings). Under this heading are included lectures on types of orebodies, origin of ore deposits, structural relationships of orebodies, and outcrops of orebodies. In addition to frequent citation of specific examples during the above lectures, one period is spent on the geology of some major American mining districts and one period is spent on promising localities for new ore deposits in Idaho. The last-mentioned topic generally brings about the most intense post-class symposium of the course.

Laboratory work during this part of the course is concerned with identification of ore minerals and use of topographic maps. Topographic maps used in the laboratory are all from western mining districts or from the Pocatello area.

3. Prospecting Methods (three meetings). One period is devoted to surface prospecting methods and one period to diamond drilling and underground prospecting. During the remaining period, the Geiger counter and "Mineralight" (ultra-violet prospecting unit) are demonstrated and simple geochemical prospecting methods are discussed.

Laboratory work includes exercises with geologic maps and aerial photographs. Geologic folios are used for the map problems. Aerial photographs from the Pocatello area are examined with the aid of pocket stereoscopes. Stereoscopic examination of a familiar area usually brings youthful exclamations from even the oldest prospectors.

4. Mining Laws (one meeting). United States mining laws and Idaho mining laws are discussed in an abbreviated form and claim-filing procedure is presented in detail. A lode claim notice for a ficticious area is completed by the class.

5. Development and Mining Methods (two meetings). This section is devoted to general sampling procedure, interpretation of assay results, and small-scale mining

methods. Practical mining detail is left to the individual student's past experience. Lacking this, the potential prospector is advised to combine forces with an experienced miner. Drilling, blasting, and timbering procedures are outlined and a few placer mining methods described.

In the laboratory students identify industrial minerals and the less common ore minerals. Meanwhile, though this is not on the program, many plans are developed for the coming summer's exploration--with the aid of available maps and aerial photographs.

A one-day field trip to a nearby mining district completes the course.

A prospecting course can provide a mutually beneficial link between townspeople and the geology faculty in many colleges--especially those located near mining country. There is a large amount of personal enjoyment for the instructor in teaching such a group. Men who have had little opportunity to attend college often enter into the study of geology with an enthusiasm which cannot be approached by the younger students. Each postclass discussion brings forth new observational data on the nearby mountain country. The relationship between the college and prospectors does not end with the completion of the course. Return visits are common, and nearly everyone remembers to bring along some new specimens or a rock suite for the geology department.

STORAGE OF HAND-SPECIMEN STUDY COLLECTIONS

William F. Read
Lawrence College

In visits to geology departments at various colleges and universities I have seen many different ways of storing rocks, minerals, and fossils in study collections for students. None has seemed more satisfactory, however, than the method of storage developed over the years at Lawrence College. I am therefore offering a brief description of this method with the hope that some of the ideas presented may be useful to others.

All of our study specimens are kept in small pasteboard trays--a practise widely followed in other institutions. We differ, however, in having adopted only two standard tray sizes: 1 x 4 x 5 inches and 1 x 5 x 6. Trays of these sizes may be secured from any paper box company. It will be observed that the width of the larger trays is the same as the length of the smaller trays.

The main advantage of standardization of the tray sizes is that they can be fitted interchangeably into slots a little more than five inches wide made by attaching narrow wooden strips to the bottoms of our storage drawers, as shown in Figure 1. The strips keep the trays in neat rows and prevent them from slipping sideways if the space in an adjoining row happens to be unoccupied. Within a row the trays are kept in place by movable wooden blocks illustrated in Figures 4 and 5. Since all trays are firmly held whether the drawer is full or not, considerable space may be kept open in each drawer for the insertion of new specimens. Anyone who has worked with half-full drawers of unanchored trays knows how annoying it is to have the trays continually sliding around and getting out of place.

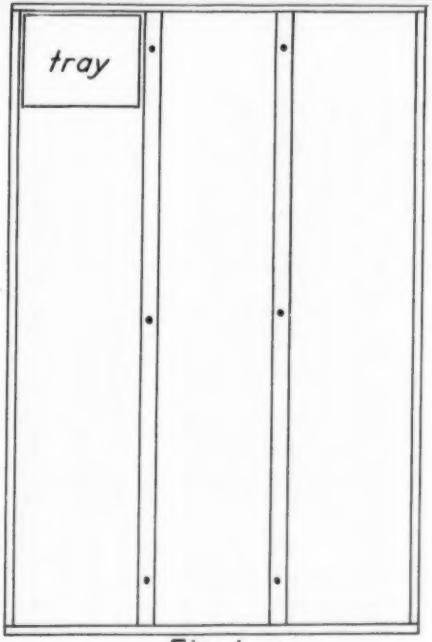

Fig. 1
Top view of drawer

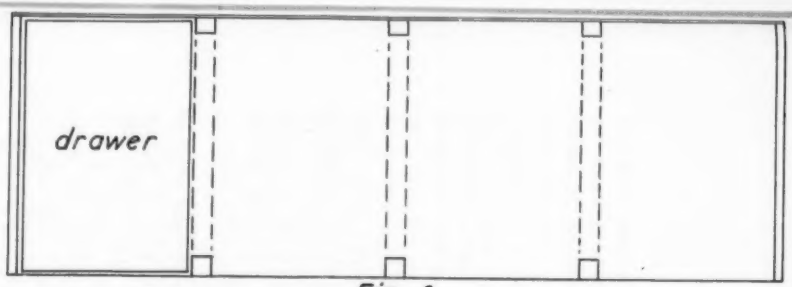

Fig. 3
Horizontal section thru cabinet

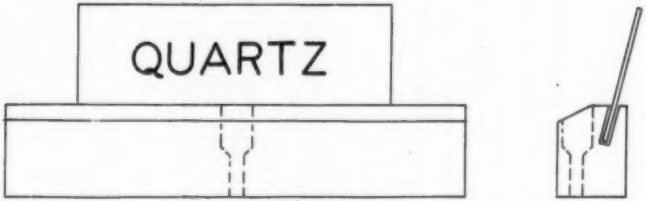

Fig. 4
Label block

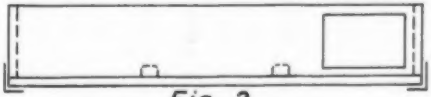

Fig. 2
End view of drawer

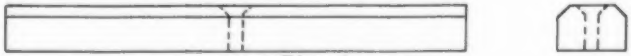

Fig. 5
Holding block

We use relatively few of the larger trays. The 4 x 5 size accommodates the vast majority of our specimens. Many specimens could, in fact, fit into much smaller trays. We have learned by experience, however, that the minimum tray size should be determined, not by the size of the specimen, but by the size of the label necessary to tell the student what he should look for. This is perhaps the most important point in our entire system. We believe that a study specimen for which the label gives only the identification, source, and name of collector is of relatively little value to students. At least a full paragraph of explanation is necessary in most cases. If anything, we are inclined to think that our trays are a little too small for the labels we should like.

The standard methods are used for preventing misplacement of specimens and protecting labels from getting smeared. Each label is numbered to correspond with a number on the specimen. Thus students may pass specimens around to quiz each other without running the risk of returning them to the wrong trays. Soft "dirty" mineral specimens like pyrolusite and graphite and corrosive ones like marcasite, are separated from their labels by rectangular pieces of plate glass cut to fit inside the 4 x 5 trays. Since the pieces of glass are all the same size, a ten years' supply may be secured very economically at one time from a local dealer.

The blocks we use to hold trays within each drawer slot may be cut from long strips easily turned out in the average college or university carpentry shop. They are of two types. One, shown in Figure 5, is simply a holding block. It may be screwed in place wherever necessary either to hold trays or separate groups of trays. The screw used should be long enough to enter the bottom of the drawer but not go through it. The second type, illustrated in Figure 4, is used to hold upright labels referring to groups of trays. It is placed at the rear of such groups. The best material, we have found, for these labels if "Formica" or some similar hard plastic. Upright

labels made of this material are virtually indestructible. They usually develop just enough of a warp to hold them securely in the sawcut along the top of the block. Lettering may be done in India ink with a mechanical lettering device provided the gloss on the plastic is first removed with fine sandpaper.

The drawers we use have outside dimensions of 3½ x 18 x 27½ inches. The sides and bottoms are of 3/8-inch white pine. The corners are dovetailed (square-cut), and the bottoms nailed. These drawers were made for us in quantity by a wooden box company, and we built cabinets around them. They have proved very satisfactory. Strips three quarters of an inch wide and a half inch high (same cross-section as the holding block, Figure 5) provide satisfactory slots for the 5-inch trays in drawers of this size. If drawers of different dimensions are already available, the strip width and tray size may be adjusted accordingly.

The basic construction of our cabinets is illustrated in Figure 3. Tops and sides are made out of a single sheet of inch-thick lumber, edge-glued. The back is 3/8-inch plywood firmly screwed in place. There are no solid partitions between tiers of drawers--simply 2 x 2's screwed to the back and top, and to a brace about eight inches off the floor in front. The drawers are supported by strips of sheet metal bent in the form of an "L" as shown in Figure 2 and screwed to the sides of the cabinet and the 2 x 2's. These strips are placed 4½ inches apart vertically, allowing an inch between drawers as "head-room" for large specimens.

We have cabinets of this type accommodating as many as 48 drawers in four vertical tiers of twelve each. Smaller cabinets of similar construction are used where less space is available. All cabinets are fitted with more-or-less dustproof plywood doors--one door to each tier of drawers.

Since a number of drawers may be out on the laboratory tables at one time, we have found it convenient to number the drawers and paint corresponding numbers on the frame of the cabinet to show where each drawer belongs. This eliminates any danger of students' putting drawers back in the wrong places. Each drawer carries a large card-holder on the front outlining its contents.

Not least among the advantages of the type of storage described is that it is extremely economical. This alone will be enough to recommend it to small departments with limited budgets. In our opinion, moreover, it is as good, or better than, far more expensive storage methods which we have seen in departments that can afford "the best".

GEOLOGIC INSTRUCTION IN PENNSYLVANIA[1]

Bradford Willard
Lehigh University

The American Geological Institute is interested in a program to publicize our science. Its Education Committee, under the chairmanship of George A. Thiel of the University of Minnesota, has set up regional sub-committees to further public education in geology at all levels and by all means. The local committee for Pennsylvania consists of S. H. Cathcart, State Geologist, Harrisburg; James Dyson, Lafayette College; R. M. Foose, Franklin and Marshall College; R. E. Myers, Muhlenberg College; E. H. Watson, Bryn Mawr College; and Bradford Willard, Lehigh University, Chairman. Ralph Digman, formerly of Lafayette, but now at Harpur College, has given the committee support and valued suggestions.

Our Pennsylvania committee has not met as a body, but through correspondence has accomplished some spade work. First has been the collection of data on earth science courses in universities, colleges, junior colleges, and state teachers colleges. The list, compiled largely by Mr. Cathcart, records that geology is taught in at least seventeen of our colleges and universities above the junior level and exclusive of teachers colleges. This accounts for close to fifty per cent of the colleges and universities in the Commonwealth--a proportion, according to Dr. Thiel (letter of October 6, 1950), near the national average. The committee has no data at present on our junior colleges.

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[1]This paper was read in its original form at the annual meeting of the Eastern Section, Association of Geology Teachers, held at Lafayette College, Easton, Pa., April 20, 1951. It is primarily a call to action. Some responses to this call--in part anticipating it--are described in papers by Moss, Chaffee, and Platt which follow. --Ed.

Apparently all of the state teachers colleges offer some sort of instruction in geography, either as such or disguised in courses in general science. At least one of them announces a course in geology.

Although a complete census has not been made as yet, it seems that no secondary school in Pennsylvania, private or public, offers a course in geology.[2] That such might be given cannot be denied. Perhaps some of us fondly remember the days when we had "Physiography" in high school. The Pennsylvania Academy of Science has for years waged an unsuccessful battle to induce the State Department of Public Instruction to improve the standing of science in our public schools. Today only general science, physics, chemistry, and biology are taught. Even in these fields instruction is often inadequate and the preparation of teachers may be superficial. The prospects of introducing another field, namely geology, are dim. Yet, there should be some means of furthering our aims. In our rural schools, certainly, earth science applied to conservation should appeal. Our state ranks second in mineral production. Certainly some of our citizens are mineral conscious.

But education is not limited to the classroom. Consider local museums, science societies, service clubs, young people's groups, Boy and Girl Scouts. It should not be difficult to schedule a lecture, conduct a field trip, put on an exhibit. Press, radio, and television contacts are not to be neglected, especially if we can supply stories with local color. The American Geological Institute in its recent pamphlet, "Suggestions for a Program of Public Education" (December, 1950), accents the obvious fact that since geology contributes to national welfare and development, it needs public support. To gain such, we who are geologists should drop our technical jargon and tell the public in colloquial English what geology

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[2]An exception may be noted in the case of the Germantown Friends School. See article which follows by H. C. Platt. —Ed.

is and what it tries to do. We should explain why taxes should go to teach earth science just as they are used to support state and federal geological surveys.

The Institute suggests a careful preliminary study of the community with which one must work and to which it is planned to sell geology. How can the interest of a specific group of citizens be solicited, and, what is more important, held? Is geology now playing a role in the life of the community? Can it be made to do so? What are the local mineral industries? The conservation problems? With a knowledge of these facts, group interest may be aroused.

The Field Conference of Pennsylvania Geologists in its annual meetings arouses some public interest--or at least curiosity. However, as now constituted, the Conference discourages attendance by non-professionals and younger students. Quite different are the annual summer field trips, always in part geologic, of the Pennsylvania Academy of Science. They are well attended and of considerable local interest to both teachers and pupils. The active Junior Academy offers a field for geological missionary work as yet little touched.

During the nineteen-thirties the Pennsylvania Topographic and Geologic Survey operated a series of "Educational Field Trips in Geology." Cooperation from the State Department of Public Instruction assured advance advertising of the date, nature, and place of each trip. Half- or whole-day excursions were run, to which a picnic lunch lent informality. Guidebooks summarized the geology and supplied annotated itineraries. These trips were often so well attended that an escort of state police was needed to handle the motorcade. Teachers came with their entire classes. Why these trips are no longer given is an open question. A revival of them might be just the opening required to inject earth lore interest into our secondary schools.

Publicity appears to be our first concern. Geology must be taken down from the shelf labelled "higher education" in the store of knowledge and set in the show window where everybody can see and understand.

PROGRESS IN INTRODUCING GEOLOGY INTO SOUTHEASTERN PENNSYLVANIA SCHOOLS[1]

John H. Moss
Franklin and Marshall College

Geology in southeastern Pennsylvania schools has long been characterized by a few excellent earth science courses in independent schools and practically no courses, nor mention of geology, in the public schools. In an effort to remedy this situation, the Geology Department of Franklin and Marshall College four years ago (1948) undertook to acquaint high school students in the area with geology through a series of specially designed assembly programs at the schools. These programs were built around two kodachrome movies produced by the department showing the training and work of geologists. After presenting these programs to over 7,000 students in more than 30 schools, we have been gratified to find that in contrast to earlier days, when few if any of our incoming freshmen had ever heard of geology, most of them now have an idea of what geologists do.

Last year we undertook the second, more difficult, phase of the problem: injecting geology into the public school curriculum. Investigation showed that there was no chance of getting a geology course into the rigid high school curriculum in the state. Eighth and ninth grade general science courses offered more hope. In these courses, the instructor has more latitude in selecting the subject matter, and many teachers were looking for new, interesting material to put into their courses. In order that we might have something concrete to offer a public school teacher who wanted to teach a geology unit in his general science course, Mr. Roger Chaffee of the Lancaster Country Day School constructed an eight-week unit, which he later taught in his school with considerable success.

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[1]Presented at the third Conference on Earth Science in Secondary Schools, Wallingford, Conn., March 15, 1952.

During the winter, we also met with the Lancaster County Principals Association, whose 40 members each brought one of their science teachers to the meeting. Dr. David Delo, formerly of the American Geological Institute, and Dr. Richard Foose, head of the Franklin and Marshall Geology Department, explained the need for geologists in the world and the necessity for introducing students to geology at the school level. Mr. Chaffee and I discussed ways and means of adapting geology to the eighth and ninth grades. In the open discussion period which followed, considerable interest was displayed, but it was pointed out that there were so many subjects demanding time in general science courses that it would be difficult to expand the time for any one subject such as geology to six to eight weeks. It was also stated that so few school science teachers had training in geology that this phase of general science was usually relegated to a four or five day cursory glance at the end of the year. On this subject, several teachers suggested that the college offer an evening course in geology designed to enable those who know nothing about geology to do more with it in their general science courses. This the college will do on an experimental basis during the 1952-53 academic year.

The conclusion we have drawn from four years of dogged and, at times, frustrating efforts in southeastern Pennsylvania are as follows:

1. If geology is to return to the schools on a large scale, college geology departments are going to have to do a lot of work interesting the schools, writing up units, teaching the teachers, and generally "sparkplugging" the effort.

2. The eighth and ninth grade general science course is the easiest place at the moment to introduce geologic material into the school science curriculum. Where attempted, its reception by students has generally far outstripped the teachers' wildest expectations.

3. A way must be found to have more geology taught to prospective teachers in teachers colleges so that when they begin teaching they can capitalize on their students' natural interest in the outdoor world.

4. Meetings with county principals associations are a good way of presenting the case for more geology to a large segment of the public school system.

5. Reaching the ultimate goal of a half- or full-year course in geology at the high school level would be greatly aided by the offering of a "college board" examination in geology and the acceptance by all colleges and universities of school geology courses as fulfillment of science entrance requirements. On this point, college geology departments can do some missionary work.

No report on southeastern Pennsylvania would be complete without mention of the splendid work in high school geology effected by many of the independent schools. Two of these courses are described in the articles which follow. Mr. Chaffee's geology unit is unique in that he has had no formal training in geology, yet by taking advantage of offers of assistance from a college geology department he was able to build a highly successful unit. Mr. Howard Platt's courses at the Germantown Friends School have long enjoyed the reputation of being the finest in the Philadelphia area.

A UNIT IN GEOLOGY AT THE LANCASTER COUNTRY DAY SCHOOL IN PENNSYLVANIA[1]

Roger T. Chaffee
Lancaster Country Day School

In the spring of 1951 the author was invited to take a few pupils on a geology field trip sponsored by the Geology Department of Franklin and Marshall College. This trip was so well organized that all the pupils came back with numerous rocks, minerals, and fossils, plus a great deal of interest in geology. During the remainder of that school year this interest continued to grow. It was soon evident that a real educational opportunity presented itself in this field.

Not only were the pupils interested in geology but also it met the desire of the teacher to improve the process of conscious, intelligent action on the part of the pupils. It was felt that the subject matter offered in a geology unit would challenge the intelligence of pupils, provide for individual pupil differences, and afford an opportunity for teaching notebook work, research, library work, etc. The teacher was offered a means of enlarging the pupils' interest in science, and of improving their maturity of thought through dealing with familiar natural objects and processes.

Numerous geology units were read in an attempt to find one suitable for our use. None seemed to meet the specific needs of our pupils. The writer therefore asked his eighth grade science class to write down the questions they would like answered about geology. Fifty-eight different questions were presented by the pupils. A geology professor at a

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[1]Preliminary plans for this unit were described by the writer at the third Conference on Earth Science in Secondary Schools held at the Choate School, Wallingford, Conn., March 15, 1952.

nearby college was then asked to make a list of questions he thought a geology unit should answer. As it turned out, the professor's questions, with the exception of a few advanced topics, covered almost the same subject matter as the questions suggested by the pupils. Therefore the geology unit was built upon the questions asked by the pupils.

These questions were organized under the following topics: Composition of the Earth, Rocks, Minerals, Underground Water, Running Water, Glaciation, Wind Action, and Geological History of Lancaster County. The local history is of special interest because of industrial development of mineral resources in the community. The various questions under each topic were either placed on the board for the pupils to copy into their notebooks or mimeographed and passed out to them. A few questions were assigned each day. On the following day these questions were discussed and the pupils were required to write the answers to the questions in their notebooks.

In the science room, the pupils had access to over thirty books, which they checked out each day. These books, for the most part, were college geology textbooks. Surprising as it may seem, the pupils had little difficulty with them and were fascinated by the pictures and diagrams.

Four field trips were taken. Although these field trips were held on Saturday mornings and were optional, all the pupils showed up for all the trips. A question sheet was passed out at the conclusion of each trip for the pupils to complete and bring to class on the following Monday.

Ten trays of fifty-seven rocks and minerals were prepared. This enabled each student to have a specimen of the rock or mineral in front of him to examine whenever it was discussed. When the hardness scale was discussed, each pair of students had a complete set of the reference minerals, from one to nine, in a separate tray. They used this set to test

the hardness of their other rocks and minerals. To prevent the possibility of the pupils' memorizing specimens by their positions in the trays, the teacher walked around the room with samples similar to the ones in the trays in his pocket. When the pupils thought they knew the rocks in their trays they were asked to identify one of the samples given to them by the teacher.

At all times during the unit the interest of the pupils was apparent. During the class discussions the pupils asked many questions that supplemented the questions assigned. The reading reports required each week showed that the pupils were reading much more than the assigned readings. Rock collections were not required, but all but three pupils produced a collection for extra credit. Charts and models were built, though not required. Many diagrams, drawings, write-ups, and pictures--not assigned--were included in the pupils' notebooks.

From the preceding it will be apparent that this unit in geology did challenge the pupils' intelligence and intensified their interest in the subject. It helped to acquaint them with the nature and origin of their earthly environment and gave them some ability to interpret this environment and to appreciate it more fully. Geology will continue to be taught at the Lancaster Country Day School.

GEOLOGY AT GERMANTOWN FRIENDS SCHOOL[1]

Howard G. Platt
Germantown Friends School
Germantown, Pa.

I teach a junior high school class in what is chiefly physical geology. Students are interested in such phenomena as earthquakes, ground water, volcanic activity, etc. It is my feeling that the course achieves maximum vitality by following up the purely scientific aspects of these phenomena with due consideration of their impact on man. I have divided my course into nine units of study. These include Soil Erosion and Rock Weathering, Rivers and Lakes, Subsurface Water, Glaciation, Volcanoes, Earthquakes, Prehistoric Reptiles, Prehistoric Mammals, and The Ocean.

At the beginning of each unit a set of questions is given to the class. These will be answered by the joint contributions of the instructor and the class. A list of magazine articles and books bearing on the subject is also presented. In addition, each student is given a copy of a magazine or book bearing on the unit being studied. The student reads the material given him, makes a few notes, and then exchanges with another student for a different article. Each student prepares a notebook in which he keeps a record of what he has read or done and the approximate time taken. They are asked to put in only three periods of home study a week but the tendency is to do a great deal more than this. Each unit lasts about four weeks. Notebooks are graded about half way through and at the end of each unit. No text is used as such, but a second-hand copy of a college text is used for reference. One would hardly expect junior

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[1]A brief statement on this subject was presented by Mr. Platt at the third Conference on Earth Science in Secondary Schools held at the Choate School, Wallingford, Conn., March 15, 1952.

high school students to read extensive sections of a college text, but they do get a great deal from the pictures and diagrams. At least one model illustrating some phase of the work is made by each student during the year.

There is a veritable host of magazine articles in this field. These, plus reference books, greatly reduce the need for text work. I am convinced that the methodology employed in this type of work is very important. The student can be induced to cover a great deal of ground by the technique of exchanging readings. Naturally the more ground the student covers and records on his notebook "readings sheet" the greater will be his reward. In no sense is this a spurious reward as the more he reads the more he will know about the subject and the greater will be his contribution to class discussion. For a teacher to employ this method he must have available files of some or all of the following magazines:

National Geographic Magazine
Scientific American
Readers Digest
Science Digest
Nature Magazine
Natural History
Scientific Monthly
Travel
Holiday
Rocks and Minerals

Several sets of The World Book and Compton's Encyclopaedia are also of great assistance for reference reading.

The questions which are presented as a spur to reading are not necessarily to be answered by the individual student. They are answered in the general class discussion. The student does the reading and research so that he may take part. Some classes are devoted entirely to reading. Work started in class is more easily carried forward at home than work begun there at the end of the day.

A word is in order as to some of the ways of relating physical geology to the economic and social scene. The problem of soil erosion is inextricably related to the history of man's struggle to make a living. One may consider wind erosion in relation to the problem of dust storms in our short-grass states. The unit on rivers and lakes offers opportunities to study methods of flood control. The study of a meandering river might start with some quotation from Mark Twain regarding his experiences as a pilot on the Mississippi and might consider the present day contortions and braiding of the Rio Grande in relation to Mexican boundary problems. The behaviour of the Red River disturbs the peace between Texas and Oklahoma. Which side owns a boundary river anyway? The Ohio and the Connecticut offer interesting studies here.

The great caves of our country are an incentive to study the subject of ground water. So too is the present day problem of our lowering water table. Ground water was partly responsible for the slides in the Culebra Cut. The sink holes of Cuba are the source of our Havana tobacco. So one can go on, even associating the Kentucky Derby with the blue grass of that state nourished by the underlying limestone.

The effect of glaciation, past and present, on the American scene has its many practical aspects, from the deep till soils of Wisconsin to the drowned shoreline of New England with its fine harbors and resultant shipping and fishing industries. And so it goes with other areas of geology such as earthquakes, vulcanism, and the geology of the ocean.

I also teach a semester course in the eleventh grade which is chiefly concerned with historical geology. Along with this runs a consideration of economic geology as items of economic interest appear in the different geological periods. The chief interest and concern in this course is the evolution of living forms, with due consideration for the influence of changing climate and land forms. In this

course the student does use a textbook but is encouraged to do a great deal of collateral reading in areas which may take his fancy. These readings may range anywhere from Hoyle's "The Nature of the Universe" to the works of Professor W. C. Allee. Field trips are taken as in the junior high school course.

One last word: perhaps in the final analysis the study of geology aside from its professional aspects should be encouraged simply to make life more interesting. It can play a great part in developing what we have heard called our "inner resources". Every trip we ever take, whether we will or no, will then in a sense be a field trip. A new world of interest may be opened for the traveler, a world of whose existence he would otherwise have been unaware.